

REMARKS/ARGUMENTS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 57, 58, 62-67, 69-75, 77-83, and 85-101 are presently active; Claims 57, 69, 77, 86, 88, 90, 92, 95, 96, 100, and 101 have been presently amended, Claims 1-56, 59-61, 68 and 76 have been previously canceled without prejudice, and Claim 84 has been canceled without prejudice by the present amendment.

In the outstanding Office Action, the drawings were objected to due to an informality. Claims 86-89, 92-93, and 101 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description. Claim 101 was rejected under 35 U.S.C. § 112, second paragraph, for being indefinite. Claims 57-58, 62-67, 69-75, 77-83, and 85-94 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description and for not being enabled. Claims 95-100 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Jinriki et al (Jap. Pat. No. 02-283,022) in view of Harris (U.S. Pat. No. 5,698,472). Claims 57-58, 63-67, 71-75, 77-83, 85, 90-91, and 94 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Jinriki et al in view of Bersin (U.S. Pat. No. 4,687,544) or Green et al (U.S. Pat. No. 5,863,843) or Ishii (U.S. Pat. No. 5,863,843). Claims 62 and 70 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Jinriki et al in view of Bersin or Green et al and further in view of Jap. Pat. No. JP1-298,003 A or Harada et al (U.S. Pat. No. 5,792,326). Claims 86-89, 92-93, and 101 were indicated as being allowed if rewritten to overcome the 35 U.S.C. § 112, second paragraph, rejection and to include all of the limitations of the base claim and any intervening claims.

Firstly, Applicants acknowledge with appreciation the indication of allowable subject matter in Claims 86-89, 92-93, and 101.

Next, regarding the drawing objection, the element formerly labeled “224” on Figure 14 has been changed as suggested in the Office Action to “244” to indicate that this element is a showerhead. Thus, it is respectfully submitted that the drawing objection has been overcome.

Regarding the 35 U.S.C. § 112, first paragraph, rejection, Claims 86, 88, and 92 have been clarified to define that the gas injection pipes arrayed to form a grid of the showerhead have a projection area projected on the target process object, which is smaller than 20% of a surface area that the target process object has. The reference to a “container-shaped lid” has been removed from Claim 101. Independent Claims 57, 69, 77, and 90 have been amended to define that the gas injection holes are directed into the process vessel toward the target process object, as suggested in the Office Action. Thus, it is respectfully submitted that the 35 U.S.C. § 112, first paragraph, rejection has been overcome.

Regarding the 35 U.S.C. § 112, second paragraph, rejection, the “container-shaped lid” recitation has been removed from Claim 101. Thus, it is respectfully submitted that the 35 U.S.C. § 112, second paragraph, rejection has been overcome.

Regarding the present claim amendments, Applicants submit that, as defined in the present claims, the present invention is directed to a modification method. In this modification method, a process gas containing oxygen atoms is supplied into a process container, and active oxygen atoms derived from the process gas are used to modify a metal oxide film formed on a surface of a target process object. Applicants submit that active oxygen atoms introduced into the metal oxide film can function to remove carbon impurities in the film and replace defects in the film with oxygen atoms. As a consequence, it is possible to form an accurate film, which can reduce leakage current and improve breakdown voltage.¹

¹ Specification, page 45, lines 4-12.

Regarding the cited references in the Office Action, Jinriki (the primary reference) discloses nothing about a supply of a process gas through a showerhead, as acknowledged by the Office Action on page 7, lines 19-21. As a consequence, the Office Action combines Jinriki with other cited references. However, almost all of the references cited in the Office Action relate to a process for forming a metal oxide film rather than a process for modifying a metal oxide film. For example, Harris discloses a method of forming a thermal SiO₂ insulating film 15 on a SiC semiconductor layer 18 by thermal oxidation, while irradiating the semiconductor layer 18 with UV light 13. Similarly, Green discloses a method of forming a thermal SiO₂ film on a substrate in a rapid thermal processing (RTP) apparatus. As such, neither Harris nor Green et al disclose methods applicable to metal oxide film formation or modification. Meanwhile, Bersin does not relate at all to forming or modifying a metal oxide film. Rather, Bersin discloses a method of etching a photo-resist film by remote plasma and UV irradiation. The UV irradiation in Bersin is used for improving the etching rate or photo-resist stripping rate.

Accordingly, Applicants submit that it is unreasonable to deny the patentability of the present invention, by relying on simple combinations of teachings from such disparate references involving different fields of endeavor. M.P.E.P. § 2141.01(a) states that, in order to rely on a reference as a basis for rejection of an applicant's invention, the reference must either be in a field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the inventor was concerned. M.P.E.P. § 2141.01(a) quoting from In re Clay, 966 F.2d 656 notes that a reference is reasonably pertinent if, even though it may be from a different field from that of the inventor's endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem. In the present case, thermal SiO₂ oxidation and photoresist etching are different fields of endeavor from metal oxide modification (i.e., the

subject matter of the present invention). Furthermore, an inventor in considering the problem of how to modify an existing metal oxide film would not have considered thermal SiO₂ growth or photoresist etching to be fields that would logically commend solutions to modifying a metal oxide film for improvement of the electrical characteristics of the metal oxide film (i.e., the problem discussed above).

For these reasons, Applicants respectfully submit that the present 35 U.S.C. § 103(a) rejections are improper and should be removed.

Moreover, independent Claims 57, 69, 77, and 90 presently define a showerhead having *gas injection pipes arrayed to form a grid*. Applicants submit that this showerhead can supply a process gas to a target process object more uniformly, as compared to a simple gas supply nozzle or ring showerhead. As a consequence, a metal oxide film formed on the surface of the target process object can be subjected to a modifying process with a higher planar uniformity. In particular, Applicants point out the positional relationship between showerhead and UV radiating system and the projection area of the gas injection pipes arrayed to form a grid defined in Claims 86, 88, and 92, as one example where it is possible to efficiently use energy of UV rays and to reduce problems caused by exciting process gas in the showerhead.

Applicants respectfully submit that none of the references cited discloses a modifying method that utilizes a showerhead having gas injection pipes arrayed to form a grid.

The Office Action on page 8, lines 3-14, acknowledges that neither reference discusses whether the shower-head's construction has a plurality of pipes in a grid, asserts that it would have been obvious as "a matter of competent workmanship" to make the illustrated holes in Bersin or Green et al extend in a 2-D array or grid, and puts forth as support of this modification Ishii (Fig. 3-4; col. 4, lines 14-28) for providing pipe arrangements with plural holes to distribute gas delivery.

To this assertion, Applicants respectfully remind the examiner that In re Rouffet, 149 F.3d 1350, sets forth criteria for being certain that *impermissible hindsight* is not being used. In particular, the court noted that the Board did not explain what specific understanding or technological principle within the knowledge of one of ordinary skill in the art would have suggested the combination. Instead, the Board merely invoked *the high level of skill in the field of art*. In the present case, the outstanding Office Action appears to be impermissibly relying on the high level of skill in the field of art (i.e., “a matter of competent workmanship”) for the asserted modification of Bersin or Green et al and for the replacement of the singular plenum 35 in Bersin or the singular quartz showerhead 315 in Green et al with pipes arrayed to form a grid, as defined in independent Claims 57, 69, 77, and 90.

Furthermore, Figure 3 of Ishii relied upon in the Office Action for teaching an arrangement with plural holes to distribute gas delivery does not show gas injection pipes arrayed to form a grid. Rather, Figure 3 of Ishii shows a singular pipe formed into a helical shape. Moreover, Figures 11 and 12 of Ishii show another singular pipe formed into a loop. In this regard, Ishii’s teaching of a singular pipe in both configurations teaches away from the present invention of having gas injection pipes arrayed to form a grid.

For all these reasons, it is respectfully submitted that the 35 U.S.C. § 103(a) rejections to independent Claims 57, 69, 77, and 90 are improper and should be removed.

Regarding independent Claim 95, Claim 95 defines the steps of enclosing the target process object on the worktable by a cover and supplying a process gas to form a horizontal gas flow of the process gas above the target process object in the cover. According to this arrangement, the process gas flow can be formed close to the target process object, so that a process gas and the energy of the active oxygen generating system are efficiently used. Furthermore, since the process is performed while a horizontal laminar gas flow is formed on the target process object, a metal oxide film can be subjected to a modifying process with a

higher planar uniformity. In this respect, Applicants submit that none of the cited references discloses a modifying method of enclosing a target process object on a worktable by a cover and supplying a process gas to form a horizontal gas flow of a process gas above the target process object in the cover. For example, Harris relied on in the Office Action for its teaching of a uniform gas flow shows in Figure 1 by the arrow 10 a gas flow impinging on the holder 5, and more specifically shows in Figure 3 oxygen molecules 11 being directed vertically toward the substrate 6, not flowing in a horizontal laminar gas flow. As such, Harris teaches away from the claimed invention, and independent Claim 95 is believed to define over the combination of references cited in the Office Action.

Accordingly, it is respectfully submitted that independent Claims 57, 69, 77, 90, and 95 and the claims dependent therefrom patentably define over the combination of references cited in the Office Action.

In view of the present amendment and in light of the foregoing discussion, it is respectfully submitted that the pending claims are allowable and that the case is in condition for allowance. An early and favorable action to that effect is respectfully requested.


Respectfully submitted,

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Amendments to the Drawings

The attached sheet of drawings includes changes to Fig. 14. This sheet, which includes Fig. 14, replaces the original sheet including Fig. 14.

Attachment: Replacement Sheet.